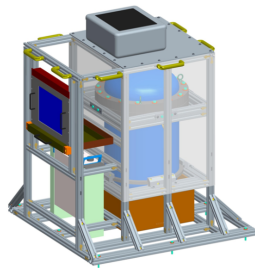




# Low-g Testing of the Radio Frequency Mass Gauge (RFMG) *PI: Dr. Greg Zimmerli, NASA GRC*

Flight Opportunities Program

## STATUS QUO



- Propellant quantity gauging in low-gravity typically requires settling burns and the use of level sensors.
- The Radio Frequency Mass Gauge (RFMG) is capable of gauging in zero-g.
- RFMG rig is ready for flight.

## NEW INSIGHTS

**Technology Focus Area:**  
Low-g cryogenic propellant quantity sensor

**Specific Benefits of Technology:** Enables fast low-g gauging

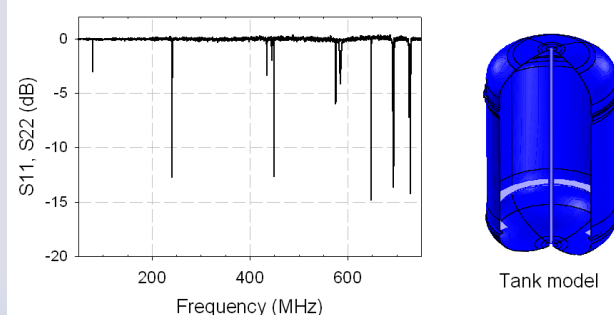
Tests on the low-g aircraft will provide critical test data to measure the accuracy of the gauge in low-g and in the presence of fluid sloshing. A different fluid fill level will be tested each flight day.

## MAIN ACHIEVEMENT:

Low-g testing of the RFMG in 2010 showed that the gauge works well when the data is filtered and averaged to mitigate the effects of sloshing. Tests in 2011 will incorporate a slosh baffle and mock "spray bar" hardware elements inside the tank to increase the fidelity of the tests. A digital RC filter will also be applied to the real-time gauge output to smooth the effects of sloshing.

## HOW IT WORKS:

The natural electromagnetic modes of the tank are excited by pinging the tank with an RF chirp signal via two small antennas mounted inside the tank. An RF electronics unit measures the RF power spectrum, and software identifies the peaks or mode frequencies. These frequencies are compared to a large database of RF simulations, and a best match occurs at some %fill level which is then reported back as the gauged %fill level.



## SPEC'S/ IMPACT

**Test Fluid:** Fluorinert FC-77

**Rig Mass/Dimensions:**  
465 lbs; 45" x 43" x 53"

**RF power:** < 1 mW

**Frequency:** 50 – 750 MHz

**Gauging operations:** Once per second, continuously

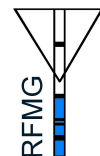
**IMPACT:** The RFMG provides a way to quickly gauge a tank in low-gravity without having to apply a settling thrust.

## END-OF-PHASE GOAL

**Demonstrate zero-g gauging at several different fluid fill levels**

- Advance elements of the technology to TRL-6 through low-g flights

- **Future:** Infuse RFMG technology into commercial launch vehicles and space-based payloads



The Radio Frequency Mass Gauge enables low-gravity gauging of cryogenic propellants.